
Space Weather Technical Forecast

Issued on Saturday, 03 February 2024 at 13:15 Local

This technical forecast provides a four day assessment of space weather events. The probabilities stated below are for reaching or exceeding the given levels. For more information about space weather impacts please see the Met Office Space Weather Scales <https://www.metoffice.gov.uk/weather/learn-about/space-weather/uk-scales>

Space Weather Forecast Headline: Chance of R1. Peak Chance of G1 Sunday 04 February.

Analysis of Space Weather Activity over past 24 hours

Solar Activity: Solar activity, as measured by GOES16, has been Low, with the peak flare in the last 24 hours a C7.7 around 03/0554UTC.

There are now seven sunspot regions on the disc. AR3575 has changed the most significantly, becoming more compact and developing a delta region. AR3565 has shown minor growth recently, while AR3567 has faded. AR3571 has produced a number of flares in the last 24 hours despite its relative simplicity. Other spots have remained fairly stable.

Overall, at the time of writing, no new CMEs appear to carry any Earth-directed component, however further analyses are being carried out to confirm this.

Solar Wind / Geomagnetic Activity: Solar winds, as measured by ACE at L1, were reflective of a slow solar wind regime. The solar wind speed declined slightly within Background levels to around 310km/s. The solar wind density showed a roughly level tendency within typical single figures ppcc. The IMF was weak throughout, at or below 4nT, while the north-south component ranged between -3 and +2nT. The phi angle was mostly negative (towards the Sun), until 02/2300UTC when it became largely positive (away from the Sun).

The net result of the above solar wind measures was provisionally Quiet geomagnetic activity throughout.

Energetic Particles / Solar Radiation: GOES18 high energy (greater than 10MeV) proton flux is currently slightly elevated above Background levels following the M6.8 flare on 29 Jan from Ex-AR3559, but remains well below the S1/Minor Radiation Storm threshold.

GOES16 high energy (greater than 2MeV) electron flux was at Normal Background to Moderate levels. The associated 24-hour fluence was well below the Active (1e8 integrated pfu) threshold but on a slight rising trend. At 03/0001UTC the 24-hour integrated fluence observation was 5.8e6 integrated pfu.

Four-Day Space Weather Forecast Summary

Solar Activity: Overall activity is most likely to be Low, but with a chance of isolated M-class flares.

Solar Wind / Geomagnetic Activity: A CME which left the Sun at 01/0743UTC may deliver a glancing blow either late Saturday 03 February or more likely early Sunday 04 February. In addition there may be also be a fast wind enhancement from CH96/+ during this period, although likely more biased to effects on 04 into 05 February, with solar wind speeds perhaps reaching 450-500 km/s.

Geomagnetic activity is expected to start and end the four-day period Quiet, with perhaps a chance of G1 on Sunday 04 February and a slight chance of similar activity on 03 and 05

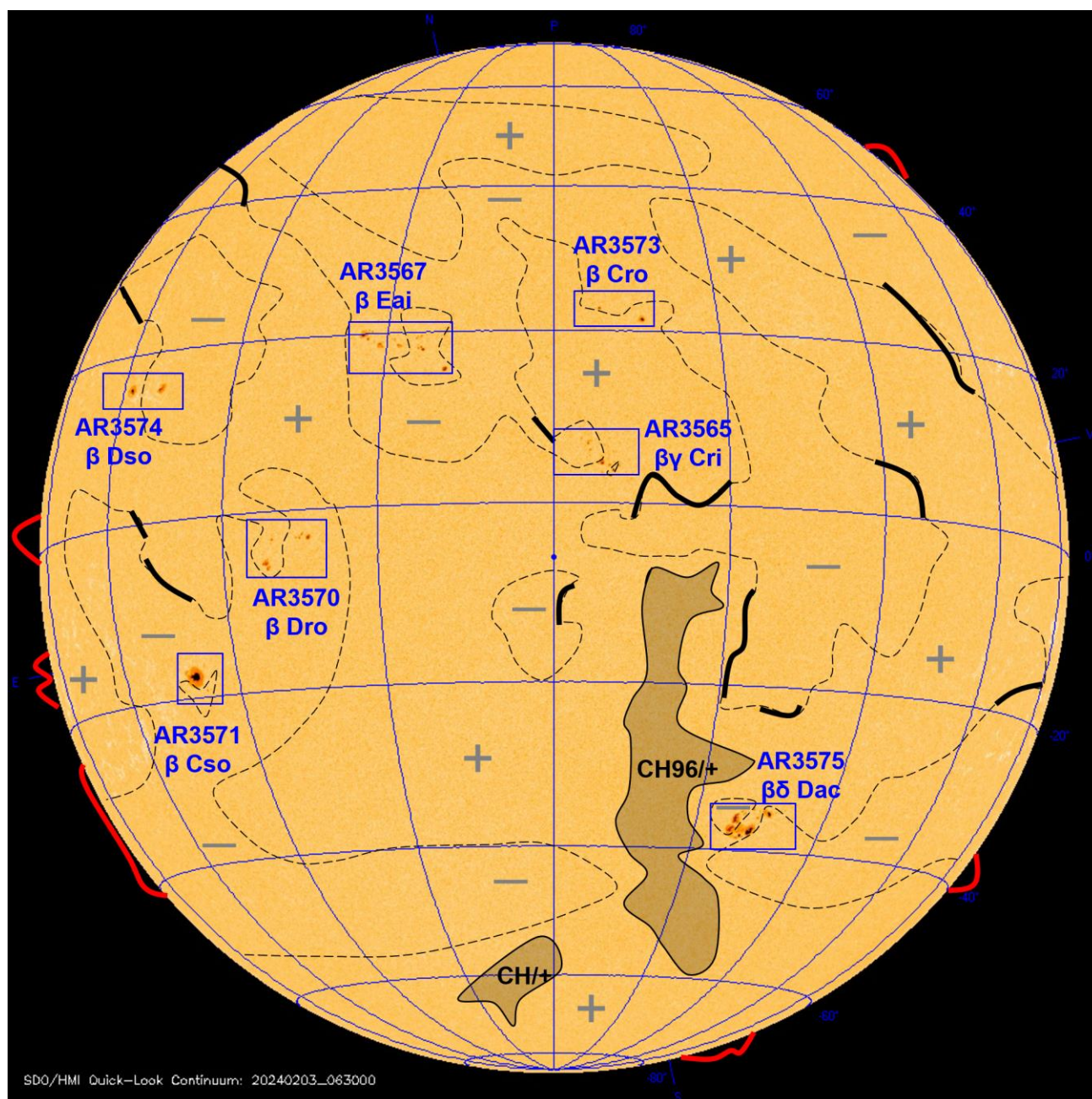
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February.

Energetic Particles / Solar Radiation: High energy proton flux is expected to remain below the S1/Minor Radiation Storm level, with a daily slight chance of exceeding the S1 threshold during the period.

The high energy electron flux (greater than 2MeV) is expected to remain below High levels throughout the period, with exceedance of the Active fluence threshold considered unlikely.

Figure 1. Solar Analysis Valid 03/0630UTC.



Key: Filament ____, Prominence ____, Magnetic Field Line - - -, Polarity +/-, Coronal Holes: Grey shaded area CHxx +/-, Sunspot groups 25xx - Mt Wilson α - β - $\beta\gamma$ - $\beta\gamma\delta$ and Zurich-McIntosh Axx etc.

Geomagnetic Storms:

A CME which originated from a long-period C3 flare at 01/0743UTC near north-centre disc, may deliver a glancing blow either later on 03 February or more likely early on 04 February. This is the only CME that features in the forecast at present, however it should be noted that confidence in this is lower than typical given the activity from AR3571. Analyses are ongoing.

In addition to the CME contribution to the geomagnetic forecast, there may be also be a fast wind enhancement from CH96/+ in the southern solar hemisphere due during this period. The majority of the HSS arrival is expected to straddle the UTC days of 04 and 05 February with solar wind speeds perhaps reaching 450-500 km/s. However, on the previous rotation, wind speeds barely reached 450 km/s with little geomagnetic response. At this time of year any response to positive polarity coronal holes is expected to be muted.

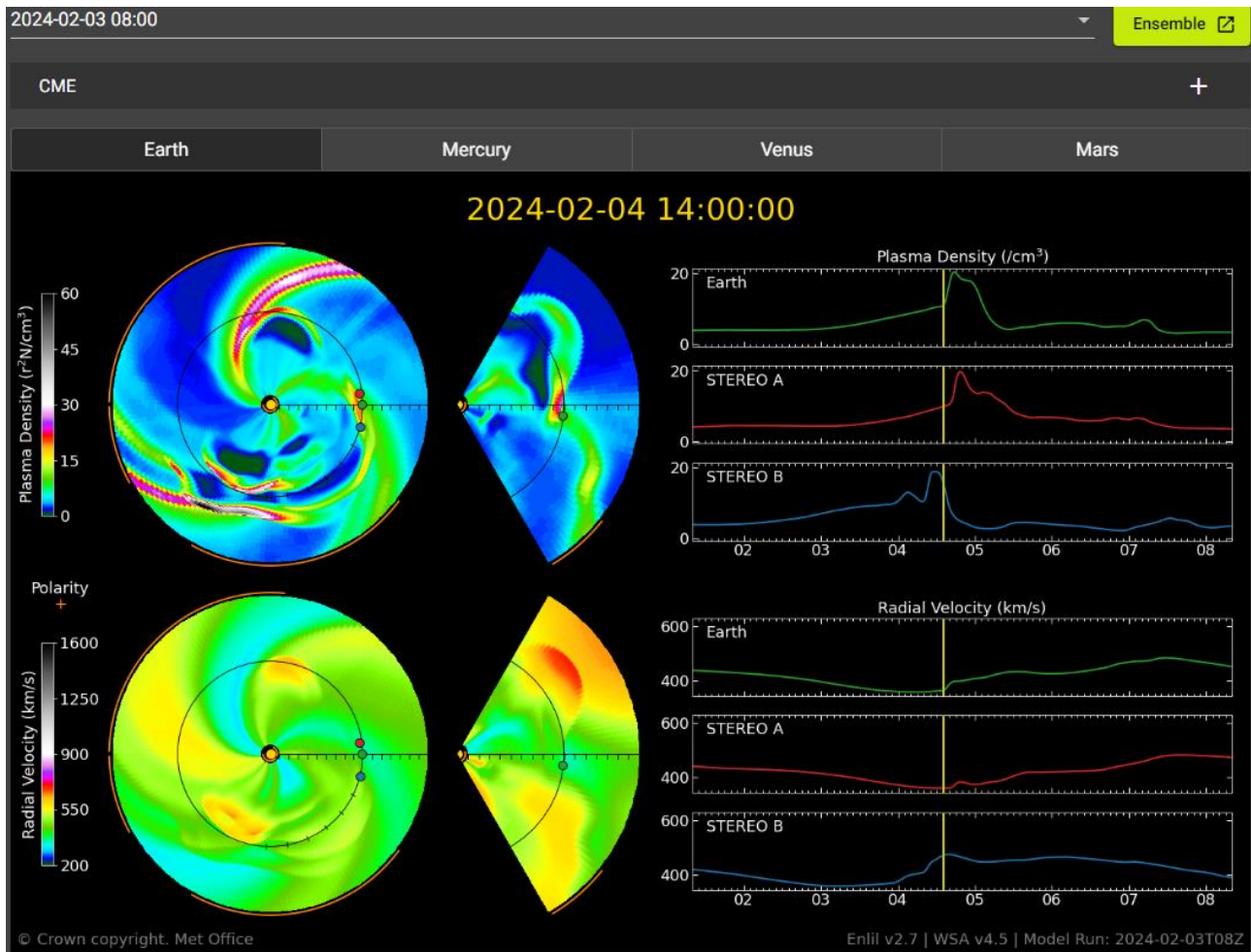
Geomagnetic activity is expected to start and end the four-day period Quiet, with perhaps a chance of G1 should any CIR leading the fast wind from CH96/+ combine with glancing CME effects on Sunday 04 February and a slight chance of similar activity on 03 and 05 February should this happen slightly earlier or later.

Geo-Magnetic Storm	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Minor or Moderate	G1 to G2	No	5	25	15	1
Strong	G3	No	1	1	1	1
Severe	G4	No	1	1	1	1
Extreme	G5	No	1	1	1	1

Geomagnetic Activity - Earthbound Coronal Mass Ejections

Date/time 21.5R (UTC)	Halo: Full or Partial	Source	Source Location	Estimated Speed	Estimated Arrival Time	Comments
01/1245	Partial	Plage area	NE	720km/s	04/0600UTC	Glancing blow possible

Figure 2: MOSWOC ENLIL showing arrival of high speed stream and CME on 04 February.



Radio Blackouts - X-Ray Flares:

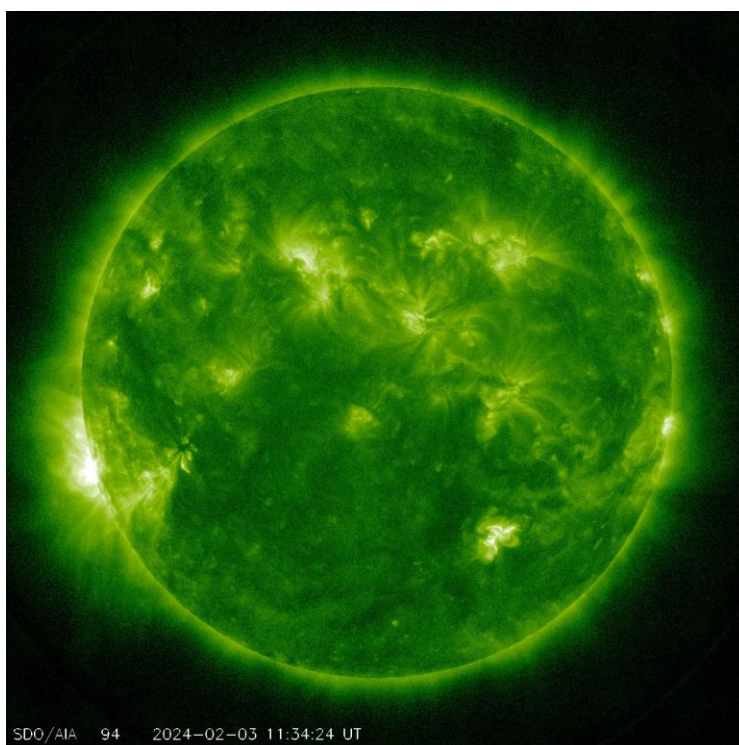
There are currently seven sunspot regions on the solar disc, with all of these apparently magnetically bipolar. Despite appearances, the most active of the past 24 hours has been one of the most tenuously bipolar regions, with very faint spots around the symmetrical penumbral main leader in AR3571. AR3671's activity and penchant for producing CMEs make it something to be monitored in the coming days as it approaches the meridian.

AR3575 has grown from an area of small, poorly-developed spots 24 hours ago to a relatively large and complex region, developing a delta within the last 6 hours as it has become more compact, with an increased risk of significant flares.

None of the current spots are expected to depart the disc in the next four days. Meanwhile, on the eastern solar horizon, the returning Carrington location for Ex-3545 is due imminently, with some far-side sounding, EUV flux looping and flaring evidence suggesting a survival in some form here.

X Ray Flares	Level	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability			(%)	(%)	(%)	(%)
Active	R1-R2 M Class	Yes	40	40	40	40
Very Active	R3 to R5 X Class	No	5	5	5	5

Figure 3: AIA-0094 showing flaring over the eastern limb.



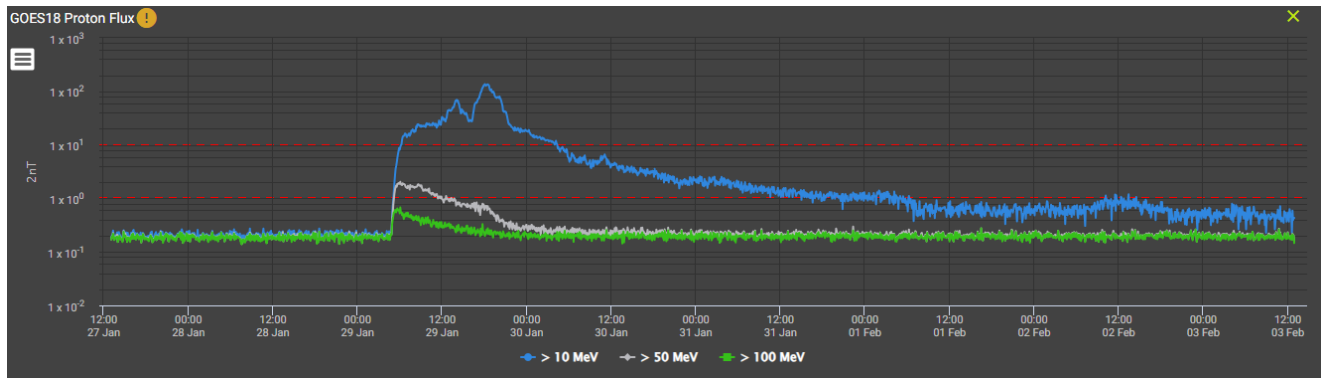
Solar Radiation Storms - (High Energy Protons):

GOES18 high energy (greater than 10MeV) proton flux remains a little above Background levels following the M6.8 flare on 29 Jan from Ex-AR3559, but remains well below the S1/Minor Radiation Storm threshold.

There remains a slight chance of reaching S1 levels should any of the regions on the disc produce any larger flares, although this is limited by the vast majority of regions lying in the less well-connected eastern solar hemisphere. The rapid growth and complexity of AR3575 make it the most likely region to produce a proton storm, particularly as it is well into the more favourable western hemisphere.

Radiation Storms	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{s}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq \text{S1}$	No	10	10	10	10
Very Active	$\geq \text{S3}$ *	No	1	1	1	1
* S3 $\geq 10 \text{ MeV} \geq 1000 \text{ pfu}$ and / or $\geq 50 \text{ MeV} \geq 10 \text{ pfu}$. (pfu = $\text{cm}^{-2}\text{sr}^{-1}\text{s}^{-1}$)						

Figure 4: GOES18 Proton Flux over the last week.



High Energy Electrons Event ($\geq 2\text{MeV}$):

High energy electron flux (greater than 2MeV) has been mostly at Background levels. Any CME or HSS effects during this period are most likely to be fairly weak, and lack impetus for a significant increase in electron flux. There is a very low risk of an increase later in the period, should there be a stronger response to the CME or inbound fast wind than expected.

Overall, the electron fluence is expected to remain well below the Active ($1\text{e}8$ integrated flux) threshold, perhaps with a slight rising trend later in the period. MOSWOC REFM's projections are currently underestimating the fluence, but still the overall below-Active trend is thought to be a good guide.

GEO Electron Environment	Level ($\text{cm}^{-2} \text{sr}^{-1} \text{day}^{-1}$)	Past 24 Hours (Yes/No)	Day 1 (00-24 UTC)	Day 2 (00-24 UTC)	Day 3 (00-24 UTC)	Day 4 (00-24 UTC)
Probability (Exceedance)			(%)	(%)	(%)	(%)
Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^8$	No	1	1	5	5
Very Active	$\geq 2 \text{ MeV}$ $\geq 1 \times 10^9$	No	1	1	1	1

Figure 5: GOES16 Electron Flux and MOSWOC REFM.

